Mechanisms of Cyclic Plastic Deformation in Metals

M.E. Kassner, Oregon State University, DMR-0090080

Transmission electron micrograph (TEM) of dislocations in fatigued copper. Classic channels are bounded by dislocation dipole bundles. Locations are indicated where convergent beam electron diffraction (CBED) was used to determine the lattice parameter in order to assess any internal stress. The corresponding absence of residual stress with varying positions in the channels suggests that the Bauschinger effect, the basic element of metal fatigue, is understood in new terms. An Orowan mechanism (backstresses unimportant) appears to be a more reasonable approach to understand fatigue. This conclusion is consistent with earlier *in-situ* cyclic deformation experiments sponsored by NSF in the high voltage electron microscope. Metal fatigue is responsible for most structural failures.

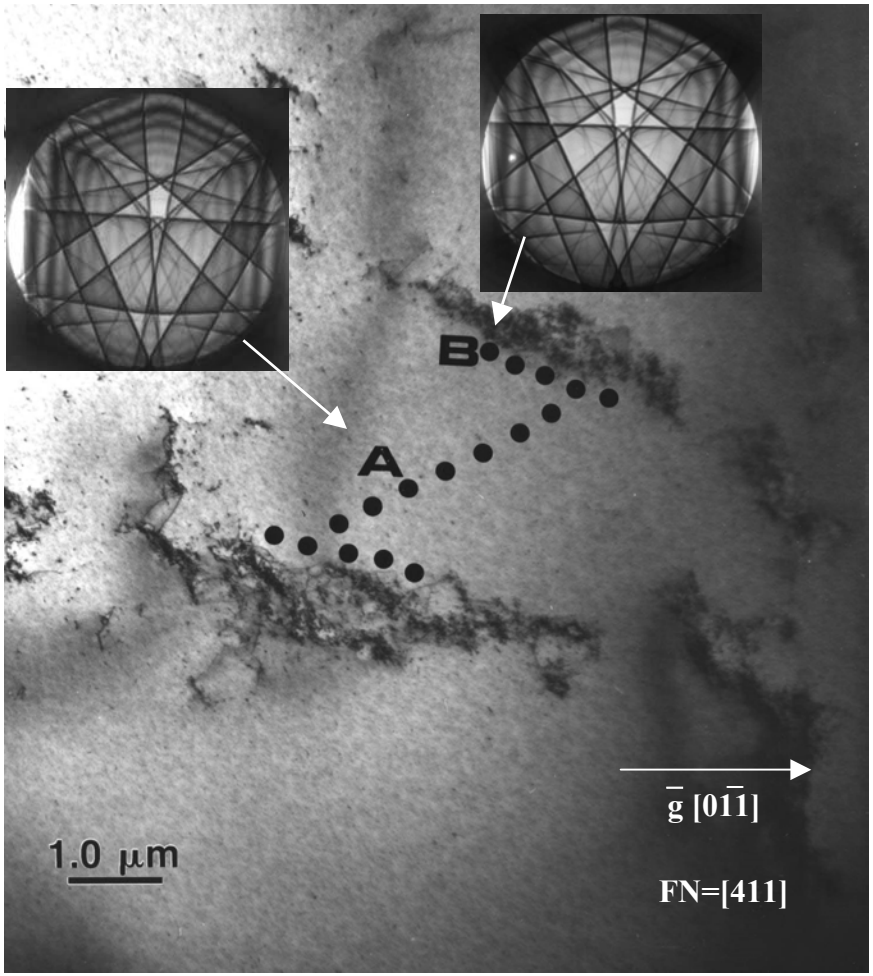

Fig. 1. TEM micrograph of dislocations in fatigued copper. Classic channels are bounded by dipole bundles. Locations are indicated where convergent beam electron diffraction (CBED) was used to assess any internal stress. Taken by Dr. Maria Teresa Perez-Prado (post-doctoral researcher).

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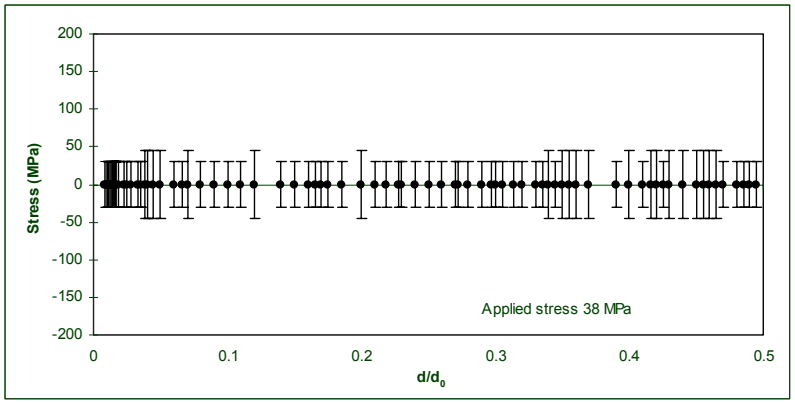

Fig. 2. The corresponding *absence* of residual *stress* with varying positions in the fatigue-structure channels suggests that the Bauschinger effect, the basic element of metal fatigue, is understood in new terms.

Graduate student Michael Delos-Reyes (middle) at University of Nurnberg-Erlangen, discussing *asymmetric line broadening* and *long range internal stresses* with (from right to left) Professors Göken (Director), Mughrabi (front), Blum (back), Ungár (Technical University at Eötvos, Budapest) and advisor Mike Kassner (Oregon State University, far left).

Publications

M.E. Kassner, M.-T. Pérez-Prado, K.S. Vecchio, and M.A. Wall, "Determination of Internal Stresses in Cyclically Deformed Cu Single Crystals Using CBED and Dislocation Dipole Separation Measurements," *Acta Materialia*, 48 , pp. 4247-4254, 2000.